

Amendments to the Drawings:

Attached are replacement sheets for Figs. 1-9 of the drawings. An explanation of the changes to these drawings is set forth in the remarks section below. No new matter has been added by way of these amendments.

Attachment: Replacement Sheets (6)

REMARKS

The above amendment with the following remarks is submitted to be fully responsive to the Office Action of September 9, 2005. Reconsideration of this application in light of the amendment and the allowance of this application are respectfully requested.

Claims 1-12 were pending in the present application prior to the above amendment. In response to the Office Action, claims 1, 4, 7, and 10 have been amended. Therefore, claims 1-12 are still pending in the present application and are believed to be in proper condition for allowance.

Referring now to the Office Action, the drawings were objected to because of various informalities thereon regarding the size of the fonts, the requirement of abbreviation “FIG.”, and the identification of Figures 1 and 2 as prior art. In response thereto, Replacement Sheets are submitted herewith with respect to all of the drawings which address these objections noted by the Examiner.

Regarding the Examiner’s objection of the drawings noting the absence of reference signs for the sweep angle (σ_r) and the camber ratios (cr1, cr2) mentioned in the description, it is respectfully noted the sweep angle (σ_r) means a slant of the blade in a rotating direction in the generic sense. The particular instances of the sweep angle as applied to the illustrated embodiment of the present invention is, in fact, indicated in FIG. 4 of the drawings as σ_{r1} and σ_{r2} , which indicate sweep angles of the blade root and the blade tip, respectively. Moreover, camber ratios (cr1, cr2) at the blade root and blade tip are not features of the fan that can be readily indicated in the drawings. Instead, they represent numerical values that are calculated based on the features of the fan. In particular, the camber ratio equals the maximum camber value divided by the cord length. Thus, the withdrawal of this portion of the Examiner’s objections to the drawings is respectfully requested.

Correspondingly, the Applicants believe the drawings are now in proper condition for acceptance, and the acknowledgement thereof is respectfully requested.

Referring again to the Office Action, various portions of the disclosure was objected to based on various informalities. In response thereto, paragraphs [08], [13], [14], [30], and [40] of the Specification have been amended above in the manner suggested by the Examiner. In addition, paragraphs [46] and [48] of the Specification have been rephrased to address the Examiner's concerns. Furthermore, paragraphs [47], and [49] to [54] have been corrected above to properly show the various symbols used in the graphs of the drawings. Correspondingly, the acceptance of the Specification is also respectfully requested.

Furthermore, claims 1 and 7 were objected to by the Examiner for the use of the term "into" in describing division. In response, these claims have been amended above to replace this term with "by" in accordance with the Examiner's recommendation. Claims 4 and 10 were objected to by the Examiner for the user of the term "and". In response, these claims have been amended above to replace this term with "or" also in accordance with the Examiner's recommendation. Acceptance of these claims is respectfully requested.

Referring now to the substantive Office Action, claims 1 and 4-6 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,312,230 to Oda et al. The Examiner asserts that Oda et al. discloses all of the limitations of the recited claims, including the recited percentage of decrease in the camber ratio. It is noted that the cited Oda et al. reference does appear to disclose the root camber ratio of 12% and 8%. However, the Applicants note that the cited portion of the Oda et al. reference appears to have been misinterpreted by the Examiner as also disclosing tip camber ratio of 3% and 5%. In contrast, the cited portion states that "a value of the bending ratio at the root portion to the value of the bending ratio at the free end portion be in a range between 3 and 5." (See Col. 5, lines 60-63). Thus, although not exactly clear, some type of proportion between the ratios

appears to be disclosed instead of actual ratios. Correspondingly, the values of the percentage of decrease as calculated by the Examiner do not appear to be accurate.

Regardless of the interpretation of the noted portion of the Oda et al. reference, independent claim 1 has been amended above in response to the Office Action to specifically recite that the camber ratio decreases substantially proportionally along a length of each blade from the blade root toward the blade tip. Clearly, the cited Oda et al. reference fails to disclose the present invention as now recited in claim 1.

In particular, it is clear from the specification of Oda et al. that the camber ratio at the blade tip is fixed in the same way as the prior art. Correspondingly, the camber ratio at the blade root of the fan is varied in Oda et al. In addition, in the fan device of Oda et al., whereas the camber ratio from the blade tip to the middle portion of the blade is increased slightly, the camber ratio from the middle portion of the blade to the blade root is increased rapidly.

In contrast, in practicing the present invention, the camber ratio is fixed at the blade root, and the camber ratio at the blade tip is varied. Moreover, as now specifically recited, the camber ratio of the present invention is decreased substantially proportionally from the blade root toward the blade tip. Thus, the primary distinctions between the present invention and the fan disclosed in the Oda et al. reference are set forth in the table below.

	Design factor		Decrease pattern of camber ratio	
Present invention	Camber ratio of root is fixed	Camber ratio of tip is variable	Gradual Decrease from the root to the tip (Root→Tip: The camber ratio is nearly proportional to the sectional position)	
Oda Patent	Camber ratio of root is variable	Camber ratio of tip is fixed	root~middle	middle~tip
			rapid increase	Substantially unchanged

In contrast to the prior art such as that disclosed in Oda et al. which is focused on improving the camber ratio at the blade root, the present invention is

focused on improving the camber ratio at the blade tip. The present inventors have found that changing the design factor of the blade tip portion located away from the hub has a great influence on the performance of the fan, more so than changing the design factor of the blade root portion adjacent to the hub. This is believed to be due to the blade tip portion having more influence on air flow and noise than the blade root since the blade tip portion has a greater rotational diameter. Therefore, the present invention is focused on optimization of the camber ratio at the blade tip which has more influence on the performance of the fan.

In view of the above, there are substantial differences in camber design between the fan of Oda et al. and that of the present invention. As noted above, in the fan of Oda et al., when the sectional position is divided into the first region of the hub side and the second region of the tip side, the camber ratio at the tip side is implemented to be substantially uniform, while the camber ratio at the hub side is rapidly increased toward the blade root. This is clearly evidenced by FIG. 6 of the Oda et al. reference which shows that at the midpoint length of the blade (i.e. 0.5 on the X-axis), the camber ratio is drastically increased toward the blade root. In this regard, Oda et al. specifically discloses relative to FIG. 6 that “a value of the bending ratio α has a first section from the free end portion 18-2 ($\beta=1$) to a middle portion where an increase in the value of the bending ratio α is very mild, i.e., the rate of increase of the value of the bending ratio α is substantially unchanged, and a second section from the middle region to the root end portion 18-1 ($\beta=0$), *where the increase in the value of the bending ratio α is sharp*, i.e., the rate of increase in the bending ratio α increases as it approaches the root portion.” (See Col. 4, lines 8-19, emphasis added).

In contrast, in the present invention now specifically recited in claim 1, the camber ratio is substantially proportionally decreased from the blade root toward the blade tip. Thus, the distribution of camber ratio for the fan in accordance with the present invention is substantially continuous along the length of the blade, and is substantially proportionally decreased from the root to the tip of the blade,

without any rapid change as provided in the fan of Oda et al. In this regard, FIG. 8 of the present application clearly illustrates that the camber ratio of the present invention is substantially proportionally decreased along the length of the blade, from the blade root toward the blade tip.

The above noted differences between the fan of the present invention and the fan of Oda et al. stem at least partially from the fact that the Oda et al. patent seeks to optimize performance by increasing (changing) the camber value at the hub side, based on the assumption that it is optimal to have the camber value uniform at the tip side of the blade. In contrast, as explained above, the inventors of the present invention have found that the change of the camber ratio at the blade tip where velocity and air flow are large, has a great influence on the performance of the fan. Thus, the present invention optimizes the camber ratio and its distribution at the blade tip portion.

Therefore, the Applicants respectfully contend that the cited Oda et al. reference fails to disclose each and every feature of the present invention as now claimed in claim 1. Correspondingly, the withdrawal of this rejection of claims 1 and 4-6, as well as the allowance of these claims, are respectfully requested.

Referring again to the Office Action, claims 2-3 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,312,230 to Oda et al. discussed in detail above, in view of U.S. Patent No. 6,027,307 to Cho et al. However, this rejection is believed to be rendered moot in view of the above comments and amendments to independent claim 1 upon which claims 2-3 depend. In particular, it is noted that the cited Cho et al. reference also fails to disclose or otherwise suggest, decreasing the camber ratio substantially proportionally along a length of each blade from the blade root toward the blade tip, as now specifically recited in independent claim 1. Because the cited Cho et al. reference fails to cure the deficiencies of the Oda et al. reference, the combination of these references suggested by the Examiner, still fails to result in the present invention as claimed.

Therefore, the Applicants respectfully request the withdrawal of this rejection and the allowance of claims 2-3.

Furthermore, claims 7 and 10-12 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,312,230 to Oda et al. discussed in detail above, in view of U.S. Patent Application No. 2003/0012656 A1. However, it is respectfully noted that the cited published '656 application has issued as U.S. Patent No. 6,908,287, and is disqualified as prior art under 35 U.S.C. 103(c) in that the subject matter of the published '656 application and the subject matter of the present application are commonly owned at the time the presently claimed invention was made, or subject to an obligation of assignment that would establish common ownership. In this regard, it is noted that the issued '287 patent (based on the published '656 application cited) and the present application, are both assigned to Halla Climate Control Corp. of Republic of Korea.

Correspondingly, because the published '656 application does not qualify as prior art, the Applicants respectfully contend that the present rejection of claims 7, and 10-12 should be withdrawn, and these claims allowed. In this regard, it is further noted that in the published '656 application, each blade has a flow dispersion region that is attained by improving a sweep angle of the blade. The present invention is directed to further improving fans such as those disclosed in the '656 application, by reducing fan noise, and improving fan performance through optimization of design factors related to the camber ratio and setting angle in the fan structure. Therefore, even if another reference with similar teachings as the published '656 application is uncovered, the applicants respectfully contend that the present invention would still not be obvious.

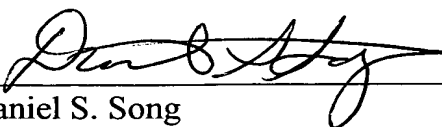
However, to expedite the prosecution of the present application, independent claim 7 has been amended in a manner similar to independent claim 1 to specifically recite that the camber ratio decreases substantially proportionally along a length of each blade from the blade root toward the blade tip. As discussed above, the Oda et al. reference clearly fails to disclose such a feature, and further

fails to teach the backward sweep angle, the forward sweep angle, and other limitations also recited in claim 7. Correspondingly, the withdrawal of this rejection of claims 7 and 10-12, and the allowance of these claims, are respectfully requested, claims 10-12 being ultimately dependent on independent claim 7.

Finally, referring again to the Office Action, claims 8-9 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,312,230 to Oda et al. in view of U.S. Patent Application No. 2003/0012656 A1, and further in view of U.S. Patent No. 6,027,307 to Cho et al. However, this rejection is now believed to be improper at least for the reason that claims 8-9 are ultimately dependent on independent claim 7, which is believed to be in proper condition for allowance and disqualification of the '656 reference as prior art. In addition, this rejection is also believed to be traversed in view of the above noted deficiencies of Oda et al. which are not cured by the cited Cho et al. reference. Correspondingly, the withdrawal of this rejection, and the allowance of claims 8-9 are respectfully requested.

In view of the foregoing, it is submitted that the present application is in condition for allowance and a notice to that effect is respectfully requested. However, if any issue remains after considering this response, the Examiner is invited to call the undersigned to expedite the prosecution and work out any such issue by telephone.

Respectfully submitted,


Daniel S. Song
Registration No. 43,143

NIXON PEABODY LLP
401 9th Street, N.W., Suite 900
Washington, D.C. 20004-2128
(202) 585-8000
(202) 585-8080 (Fax)
Customer No. 22204

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